



PHENIX
ENGINEERING DOCUMENTATION CONTROL
(Preparation and Issuances of PHENIX Engineering Drawings and Specifications)

procedure name

PHENIX Procedure No. PP-2.5.6.1-04

Revision: A

Date: 9/28/2012

Hand Processed Changes

HPC No.

Date

Page Nos.

Initials

- *Typo: Under References, "C-A OPM 02-42" should be written as "C-A OPM 2.42"*
- *Typo: Under References, PHENIX Document # PP-2.5.6.1-1, "Procedure Creation" should be written as "Procedure Preparation Guidelines"*

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Approvals

Paul A. Seaman

PHENIX Safety

Date 9-27-12
Bob Flinn

PHENIX Gas Systems Expert

Date 9-27-12

[Signature]

PHENIX Engineering

Date 9/27/12
Eric J. O'Brien

PHENIX Management

Date 9/28/2012

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PHENIX Engineering

Date _____

Date _____

PHENIX Gas Systems Expert

PHENIX Management

Date _____

Date _____

REVISION CONTROL SHEET

LETTER	DESCRIPTION	DATE	AUTHOR	APPROVED BY	CURRENT OVERSIGHT
A	Original Issue.	9/28/2012	D. Lynch	D. Lynch, P Giannotti, R Pisani, E. O'Brien	D. Lynch

Introduction

The PHENIX experiment is a large multi faceted array of detector subsystems designed to study the properties of the products of nuclear sub-particles liberated by collisions between heavy ions with other heavy ions, heavy ions with protons and/or deuterons, and proto/deuteron collisions with other protons/deuterons. The experiment is run by a multi-national collaboration of scientists, engineers and technicians from numerous institutions including universities and national laboratories from many nations. In order to facilitate the constant evolution of the experimental apparatus as the experiment matures, while maintaining an accurate and current technical description of the apparatus, a structured but flexible configuration management plan has been implemented. In order to assure that PHENIX design documentation drawings and specifications accurately reflect the current configuration of the unique equipment and facilities that make up the PHENIX experiment, such documentation is controlled and managed as described in this procedure. (Note: this document applies to unique PHENIX equipment and facilities related to the PHENIX experiment complex. PHENIX equipment and facilities related to office spaces in the PHYSICS department building are not covered by this document, but are subject to PHYSICS department configuration management policy).

The necessity for this document comes from the nature of the PHENIX Experiment itself as a large collaborative effort of scientists, engineers and technicians from around the world working together on an extremely complex apparatus, which occupies a distinct and important space within the larger Relativistic Heavy Ion Collider (RHIC) which in turn resides in the still larger entity of Brookhaven National Laboratory (BNL). Operating at this intersection of entities there needs to be clearly defined scopes of influence at each of these levels. At the BNL level, PHENIX operations are governed by the Systems Based Management System (SBMS) which describes documentation control requirements on a somewhat generic level. The SBMS recognizes that “one size fits all” documentation control guidelines are impractical and overly burdensome and provides great latitude for implementation of documentation and control at the organizational level, while still providing consistent general guidelines.

On the closer level of RHIC, configuration management and documentation control are governed by the Collider Accelerator Department (C-AD) Operating Procedures Manual (OPM). The C-AD OPM is designed to meet the more generic requirements of the SBMS with C-AD specific procedures. At this level C-AD OPM provides for guidance for implementing configuration management for all C-AD drawings and specifications with C-AD OPM 13.6.1 ***Configuration Management – Design, Drawing and Specification Control***. This OPM describes the process by which changes to the configuration of C-AD equipment and facilities are documented to assure that a reliable and consistent system reflects the current configuration of the parts, assemblies and/or complete articles which comprise the facilities and equipment managed by C-AD.

At the PHENIX level, all SBMS requirements flow down as do the requirements of the C-AD OPM for equipment and facilities which comprise the PHENIX experiment. Such equipment is divided into 2 categories: (a) equipment and facilities managed by C-AD engineering and (b) equipment and facilities managed by PHENIX engineering and/or PHENIX collaborators. PHENIX procedure # PP-2.5.6.1-03 describes the demarcations between the 2 categories and the configuration management requirements for all such equipment and facilities. Those items that fall into category (a) are subject to the documentation and control procedure described in C-AD

OPM 13.6.1. Those items which fall into category (b) are subject to the documentation and control requirements described herein.

1. **Responsibilities**

All PHENIX engineers and scientists are responsible to assure that appropriate documentation of all PHENIX experimental equipment is appropriately documented.

The PHENIX Chief Mechanical engineer is responsible for assuring that the policies outlined herein are appropriately implemented.

The PHENIX Design Documentation Control Manager is responsible for administering all PHENIX Controlled documents and drawings and assuring that all documents released for use by PHENIX technical staff and/or fabrication are approved, current and accurate.

2. **Prerequisites**

None

3. **Precaution**

None

4. **Procedure**

4.1 Design Process

The design criteria shall define, as required, the performance objectives, operating conditions, and requirements for safety, environmental protection, reliability, maintainability, and availability, as well as the requirements for materials, fabrication, construction, and testing.

A graded approach will be employed to emphasize those items that could have the greatest effect upon personnel, environmental safety, performance, cost and schedule. The cognizant engineer (CE) shall determine the proper QA Classification for the **C-A-OPM 13.6.1 “*Graded Approach for Quality Requirements*”**.

4.1.1 Design reviews permit an exchange of ideas among concerned individuals with expertise in required fields. These reviews will determine that design interfaces are compatible, that the design meets all of its criteria, that the

delineation is complete, unambiguous, and readily producible, and that the important parameters can be verified by inspection and/or test. Design reviews shall be summarized and documented. The degree of documentation shall be commensurate with the level of detail provided during the design review.

4.1.2 The following criteria determines whether a given project and/or procurement generated by such a project need be the subject of a formal design review.

4.1.2.1 Engineering or construction work, which results in the generation of a single purchase order, change order, or Central Shops Request for Work (RFW) with a dollar value in excess of \$200,000.

4.1.2.2 New system designated with an A1 Quality Classification.

4.1.2.3 Additions or modifications to existing A1 level systems, which involve changes of performance or mission. Specifically exempted from formal design review requirements are changes, improvements or upgrades to existing A1 level systems which are processed via C-A OPM 13.6.2, Configuration Management – Change Control.

4.1.2.4 Projects which will result in the procurement of more than 25 modules/boards or more than 500 non-laboratory stock components with a dollar value in excess of \$100,000.

4.1.2.5 Projects/jobs whose design must comply with the requirements of 10 CFR 851, Worker Safety and Health Program

4.1.2.6 Probability of following occurring is remote (Unlikely to occur in life cycle but possible)

- hazard can cause moderate injuries,
- local evacuation,
- accident condition > 1 rem or > ERPG-1 at site boundary for mitigated release
- ≥ 5 rem to an individual (Federal Law Violation)
- > \$50,000 or $\geq 10\%$ of item/material/program cost
- ≥ 4 days program downtime or $\geq 10\%$ of program schedule
- major loss of experimental data or equipment output have a public impact that brings the experiment to the attention of the community and activist groups or have a major impact on BNL/DOE mission and program

4.1.2.7 Probability of following occurring is probable (Likely to occur several times in life cycle)

- hazard can cause minor injuries,
- ≥ 100 mrem to an individual (ORPS trigger)
- $\geq \$10K$ or $\geq 2\%$ of item/material/program cost
- ≥ 2 days program downtime or $\geq 2\%$ of program schedule
- minor loss of experimental data or equipment output
- have a public impact that is below public perception or have a minor impact on BNL/DOE mission and program

4.1.2.8 Projects/jobs whose design has any of the following environmental aspects:

- Clearing wooded
- Excavation in previously undisturbed area
- Liquid effluent waste stream
- Underground tank
- Disturbing pre-existing soil contamination
- Chemical or fuel storage facility

4.1.3 If any of the design review triggers listed in paragraph 4.1.2 are met then the design process described in CAD OPM 13.6.1 shall be followed. For those designs/projects which fall below the listed thresholds, the responsible engineer shall implement the initiation of drawing and specifications for the project.

4.2 Drawing Preparation Process – Drawings created Locally by PHENIX Design Group

Production drawings shall contain all of the detailed requirements necessary to manufacture, purchase, inspect/test parts, subassemblies, assemblies, modules, or units.

4.2.1 The CE shall provide the Design Group with the information necessary to prepare the drawing. Design criteria approved by the Chief Mechanical/Electrical Engineer should include as applicable: performance objectives; operating conditions; and requirements for safety, environmental impact, reliability, maintainability, availability, ease of manufacture, inspection, special handling, age control requirements, etc.

4.2.2 Appropriate codes, standards and practices for material, fabrication, construction, testing, and process shall be defined in the design documentation. Where feasible, nationally recognized codes, standards and practices should be used. When these documents fall short of defining the requirements, they are to be modified, supplemented, or replaced with BNL specifications.

- 4.2.3** The Cognizant Engineer shall review the drawing to verify that the descriptions and notes are unambiguous, correct and complete, and that the drawing conforms to the proper format and design standards.

4.3 Drawing Numbering System – PHENIX Design Group

- 4.3.1** The PHENIX drawing system shall use a variable length (due to tabulation), alpha-numeric numbering system for drawings and parts lists.
- 4.3.1.1** When feasible tabulated drawings depicting similar items (which as a group, have constant & variable characteristics) will be utilized. The use of tabulated drawings precludes the preparation of an individual drawing for each item tabulated.
- 4.3.2** Drawing numbers are issued by the PHENIX Documentation Control Manager
- 4.3.3** If a number has been assigned to a drawing, and the item represented by that drawing is not used, then that particular number can not be reassigned to another drawing.
- 4.3.4** The appropriate drawing revision is entered in the revision column/box. Upper case drawing revision letters shall be used in alphabetical sequence. The letters "I", "O", "Q", "S", "X", and "Z" shall not be used. When revisions are numerous enough to exhaust the alphabet, the revision following "Y" shall be "AA", then "AB", etc.
- 4.3.5** <reserved>

4.4 Parts Lists – PHENIX Design Group

A parts list is a tabulation of parts and materials required to fabricate the assembly shown on a drawing. All assembly drawings will have a parts list which is integral/separate to the drawing.

4.5 Drawing Format– PHENIX Design Group

- 4.5.1** All PHENIX production drawings will be guided by the latest revisions of ASME Y14.00, Engineering Drawing Practices.
- 4.5.2** Cross-reference information is added to the drawing title block on sheet one. The "Used On Drawing No." column contains the drawing number(s) of the assembly(s) to which the detail or assembly pertains.
- 4.5.2.1** A "Qty. Per Assy." column contains the quantity/amount required to complete a single article. The symbol "AR" (as required) may be used in lieu of exact quantity of a bulk material. Symbols other than "AR" may be used, provided they are explained by an appropriate note or reference

document. This information may also be recorded on the parts list.

4.5.2.2 Examples of General Notes

- Applicable documents, standards, and/or specifications.
- All items listed with part number and manufacturer can be substituted with a BNL approved equivalent part.

4.6 Release process for New Drawings– PHENIX Design Group

4.6.1 The CE/Cognizant Scientist (CS) will, after resolution of any outstanding issues, authorize the Design Group to obtain drawing approval signatures.

4.6.2 Based on the QA Classification assigned to the drawing, the following approvals are required. At the discretion of the Chief ME/EE, additional review/approvals may be required. Required individuals shall review the drawing for completeness, technical content, technical accuracy, impact, and validity.

- Drawings with QA category A1 and A2 shall be reviewed and approved in accordance with C-AD OPM 13.6.1 section 5.6.2
- All other PHENIX drawings shall be reviewed by the designer and CE/CS and any other individuals whose approval may be required at the discretion of the PHENIX CE/CS

4.6.3 The revision level assigned to the initial release of baseline engineering drawings and parts lists is at the discretion of the Documentation Control Manager. The revision history box on the drawing must clearly indicate at what revision the drawing was officially released.

4.6.4 The Documentation Control Center will provide copies of released drawings upon request

4.7 Computerized Drawing Databases– PHENIX Design Group

4.7.1 Drawings generated by the PHENIX Design Group shall be created by Computer Aided Design (CAD) programs. It is the responsibility of the Documentation Control Manager to ensure that the design databases, including equipment required to read the data bases, are maintained.

4.7.2 Drawing databases shall be secured to prevent unauthorized changes. Access to these databases is controlled by the PHENIX

Documentation Control Manager.

- 4.7.3** Drawing files will be archived prior to implementation of an approved ECR. This will insure that previous revisions are retrievable without modifications. All drawing revisions will be incorporated by the PHENIX Design Group.
- 4.7.4** Backup files, tapes or drives shall be located in at least one other location other than where the databases are generated or changed.
- 4.7.5** The PHENIX Design Group shall maintain electronic copies of the engineering drawings and parts lists. The Design Group shall assure traceability to approval signatures on the initial release and ECR's for subsequent releases.

4.8 Specification Preparation– PHENIX Design Group

- 4.8.1** Specifications required for the procurement of items and/or materials, should describe the item/material, performance objectives (when applicable), and acceptance criteria.
- 4.8.2** The CE/CS is responsible for the preparation, review, approval, and distribution of C-A specifications. The responsible individual shall forward the approved original specification to the C-A Documentation Control Center.
- 4.8.3** As a minimum, the document cover page should contain a title/subject, unique number, a means of identifying the current revision, QA Category, and the authorization/concurrence (as appropriate) of the CE/CS, and QA. Subsequent pages shall contain the document number and a method for tracking revision, e.g. date and/or letter.
 - 4.8.3.1** Specification numbers are issued by the PHENIX Documentation Control Manager.
- 4.8.4** The general arrangement or layout of PHENIX specifications should include the major sections defined below. Section headings may be altered as necessary to accommodate the subject matter.
 - 1. Scope
 - 2. Applicable Documents
 - 3. Requirements- Includes requirements for Design, including reviews of Designs/ Preproduction (Qualification), Parts, Materials, Processes, Construction and Workmanship.
 - 4. Verification- Includes requirements for identifying responsibility for Tests, defines the procedures and acceptance criteria for Preproduction(qualification), Acceptance (Production) and Special Inspections and/or Tests
 - 5. Preparation for Delivery

6. Notes - Includes information pertaining to Intended Use of item, Ordering Data, Precedence of Documents, Performance Objectives, Definitions, Testing Ground Rules, Seller's Article Uniformity, and a list of Associated Equipment.

5. Documentation Created by PHENIX Collaborators

An institution in the PHENIX collaboration that has a mechanical design concept may create manufacturing drawings, specifications and models per their institution standards and procedures. They may use their own drawing formats and numbering system or may request documentation numbering from the PHENIX Document Control Manager.

5.1 Review Process for Documents Created External from BNL

Documents generated external from BNL (e.g. PHENIX Collaborators) for facilities or equipment intended for use at PHENIX shall be subject to review by PHENIX and C-AD engineering and safety prior to introduction into PHENIX. Criteria for formal review shall be the same as in section 4.1.2, above. Copies of all relevant documentation shall be provided for the review and the PHENIX Document Control Manager shall maintain copy(s) of such documentation in either or both paper and electronic format. Copies of formal review minutes and action items shall also be maintained by the PHENIX Document Control Manager.

6. References

C-A OPM 02-42 Liaison Engineer, Physicist; Project Engineer and Physicist; Liaison Scientist: Roles and Responsibilities for Modifications

C-A OPM 13.6.2 Configuration Management

C-A OPM 13.3.1 Graded Approach for Quality Requirements

PHENIX Document # PP-2.5.6.1-1 Procedure Creation

PHENIX Document # PP-2.5.6.1-2 Work Planning

PHENIX Document # PP-2.5.6.1-3 PHENIX Configuration Management

7. Attachments

Attachment 1: PHENIX Drawing Numbering System

All PHENIX Drawings created by the PHENIX Design Group shall have the following drawing number system:

XXX-YYYY-ZZZZ

Where:

XXX shall be the 3 digit number 105 for all PHENIX drawings, indicating the PHENIX project. In the future one or more other 3 digit numbers may be added to indicate a new project under the PHENIX umbrella.

YYYY shall be a 4 digit number referring to the PHENIX subsystem or subcategory as follows:

0000	PHENIX Envelope Control
0100	Magnet Systems
0101	Outer Coil (CM)
0102	Inner Coil (CM)
0103	Central Magnet Steel
0104	Muon Coil
0105	Muon Magnet Steel
0106	Muon ID Steel
0107	South MUON Magnet
0200	Detector Systems (General)
0201	MVD
0202	Beam-Beam
0203	HBD
0204	DC
0205	PC (PC1)(PC2)(PC3)
0206	TEC
0207	RICH
0208	TOF
0209	EM Cal (Pb-Sc)
0210	EM Cal (Pb-Gl)
0211	EM Cal (Csl)
0212	MuTr
0213	MuID
0214	Aerogel

0216	Flower Pot
0217	
0500	System Eng'g & Integration
0501	Detector Carriages
0502	Facilities
0503	Integration
0504	Installation & Test
0505	Detector Commissioning
0506	Safety & Environmental Protection
0508	Gas System
0510	Survey Information

As new subsystems are designed appropriate additional YYYY numbers shall be generated by the PHENIX Document Control Manager.

ZZZZ shall be a 3 or more digit number which uniquely identifies each drawing within the subsystem. If less than 3 digits are needed the zeroes shall be added to the left side of the number (e.g. drawing number 6 shall have *ZZZZ* = 006, drawing number 49 shall be 049, drawing number 325 shall be 325, drawing 1562 shall be 1562, etc.)

The PHENIX Document Control Manager shall normally issue drawings consecutively, but may skip/reserve numbers for logical grouping of sub-subsystems or any other reason deemed appropriate by the PHENIX Document Control Manager.

